REMARKS

This Amendment is in response to the Official Action of December 29, 2000 wherein the Examiner made certain technical objections to the specification, drawings and claims. The Examiner also rejected certain claims as unpatentable over Shildneck in view of Elton ('165). Further, certain claims are rejected as above and further in view of Takaoka et al. and the Siemens, UK Specification 468,827. (Siemens is incorrectly referred to as the German specification.)

With respect to the technical objections, the drawings have been amended in order to overcome the Examiner's objections. For example, in Fig. 2, the laminated core is referred to as 1'. As noted in the specification, this is a conventional element that is shown generally in the drawing.

New Fig. 4 illustrates the material set forth in claims 14, 15 and 17. No new matter has been added. A three phase Y connected winding is well known. In addition, the claims describe and disclose the circuits in sufficient detail to enable one skilled in the art to reproduce the feature. The specification has been amended in order to incorporate the claim language.

Certain claims have been amended or cancelled in order to comply with the Examiner's objections. For example, claim 27 has been cancelled because the term "pronounced" is not considered essential to the invention.

There are certain typographical errors which have been corrected. Claims 41 and 42 have been incorporated into claim 39 and the claims cancelled. In claim 50, the term "core" has been changed to "cover."

It is therefore respectfully requested that the Examiner withdraw the various technical objections.

The Examiner's rejection of the claims based upon the references of record is respectfully traversed for the reasons set forth below.

REJECTION OF CLAIMS 1-4, 6-8, 10, 12, 21, 31, 32, 34, 35 and 37 UNDER 35 U.S.C. § 103

Claims 1-4, 6-8, 10, 12, 21, 31, 32, 34, 35 and 37 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Shildneck (U.S. Patent No. 3,014,139) and in view of Elton et al. (U.S. Patent No. 5,036,165; ("Elton ('165)"). The Examiner contends that it would have been obvious to have used the cable assembly of Shildneck having semiconducting layers as taught by Elton ('165) since such a modification, according to Elton ('165), would provide a conductor which prohibits the development of corona discharge. Applicants respectfully traverse this rejection for at least the reason that there is no motivation or incentive to combine the cited references. As a preliminary matter, a brief interpretation of the Elton ('165) reference is required.

INTERPRETATION OF ELTON ET AL. (U.S. PATENT 5,036,165)

Applicants understand the Office Action to mean that the Examiner is reading Elton ('165) as disclosing a particular type of electrical cable used as a winding in a dynamoelectric machine. For the reasons to appear hereinafter, Elton ('165) does not disclose that the electrical cable shown in Figure 1 thereof may be used for windings in a dynamoelectric machine. Rather, the conductor shown in Figure 1 of Elton ('165) is used only for an electrical transmission and distribution cable.

Elton ('165) is a divisional of what is now issued U.S. Patent No. 4,853,565 (Elton ('565)). As stated in column 1, lines 5-9 of Elton ('165), the '565 patent is incorporated by reference in its entirety into Elton ('165). Therefore, although not reproduced expressly in

Elton ('165), the Elton ('165) patent must be construed as if all of the text and drawings in Elton ('565) were expressly included in and reproduced in Elton ('165).

Applicants contend Elton ('565) teach mutually exclusive embodiments (i.e., a "cable," a "bar," or "windings" in a generator). When the appropriate teaching from Elton ('565) is considered, one of ordinary skill would not see an incentive to combine it with Shildneck. Elton ('565) discloses, generally, the semiconducting layer for insulated electrical conductors in three different embodiments, none of which are a cable winding. The first embodiment (Figs. 1-6) deals with windings in a dynamoelectric machine. In this embodiment, the conductors are referred to exclusively as "windings" or "bars." The second embodiment (Fig. 7) relates strictly to an electrical cable 100 used for the transmission of high voltage. Within this embodiment, the conductor is referred to as a "cable" and not as a "bar" or "winding." The third embodiment (Fig. 8) relates to the use of a semiconductor layer disposed on an electrical housing surrounding digital electrical equipment. The conductor in this particular embodiment is referred to as a "housing" as opposed to a "cable", a "bar," or a "winding." In reviewing the Elton et al. references, the terms used were carefully chosen and applied uniformly throughout the references.

With the foregoing as background, it follows that the mention in Elton ('165) to a "dynamoelectric machine" was in all likelihood inadvertent (*i.e.*, that term, or sentences containing that term, were not deleted when the divisional was filed on the "cable" embodiment). In any event, however, why such mention to a "dynamoelectric machine" remains in the Elton ('165) patent is fairly immaterial, since, as described above, the entire contents of the Elton ('565) patent are incorporated by reference into the Elton ('165) patent. When all of the disclosure is taken together, as it must, it is clear that the conductor designated 100 in Elton ('165) relates only to an electrical cable for transmission and

distribution of electrical power, and not to a winding for a dynamoelectric machine. Any other interpretation, Applicants submit, would be contrary to the plain meaning given to the words as defined in the Elton ('165) and Elton ('565) specifications.

NO MOTIVATION TO COMBINE

The Examiner has rejected the above claims as being obvious over Shildneck in view of Elton ('165). Applicants submit that this is an improper combination of references in light of the standard regarding such a combination set forth in In Re Geiger, 815 F.2d at 688, 2 USPQ2d at 1278 (Fed. Cir. 1987). This standard is as follows: "[o]bviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, *absent some teaching, suggestion or incentive* supporting the combination." Id. (emphasis added).

Shildneck is an electric machine that possesses windings formed of cable. However, the machine in Shildneck is a high current/low voltage machine, and Applicants respectfully assert that Shildneck would not work in a high voltage application that the present invention operates in.

Shildneck describes a low-voltage, high-current machine with unconventional windings. As shown in Figs. 1-4 of Shildneck, the outermost layer of the winding (i.e., element 8 in Figures 1-4) is made of an insulation material, as opposed to the semiconducting outer layer of the present invention. One object of Shildneck is to reduce the thickness required in the ground insulation (by providing a round conductor). Eventually, corona would develop as an ionized discharge path between the insulation material and the stator. The electric discharge from the insulation material to the stator would result in a deterioration of

the insulation material, as in the end-winding region, and would ultimately lead to a breakdown of the machine when operated at high voltages.

In machines operating at higher voltages, normally between 10 and 20 kV, sometimes up to 30 kV, the coil end is normally provided with an electric-field control in the form of so-called corona protection varnish intended to convert a radial electric field into an axial field, which means that the insulation on the coil ends occurs at a high potential relative to ground. The electric-field control evens out the dielectric stress of the insulating material in the end winding region, but electric field concentrations are still a severe problem in electrical machines operating at these higher voltages. Shildneck does not have any electric-field control, and such is not needed for machines, like Shildneck, operating at low voltages. Conventional insulation of conductors in electrical machines (such as so-called mica-tape) is produced to some extent to provide resistance to partial discharge. If the ground insulation material as used by Shildneck (silicon rubber), were subjected to partial discharge, it would eventually lead to deterioration of the insulation material. Also, if Shildneck were operated at higher voltages, the uncontrolled electric field in the end winding region would also result in high electric field concentrations causing a high dielectric stress of the insulation material, leading to deterioration of the insulation material.

The "invention" in Elton ('165) is the pyrolyzed glass fiber layer. Elton ('565) describes a process of immersing the winding portions in a bath of resin and vacuum pressure impregnating (VPI) the resin in the winding. The VPI process results in a cured resin having no voids or gaps between layers. The cable shown in Fig. 1 of Elton ('165) includes two pyrolyzed glass fiber layers, layers 104 and 110.

> The internal grading layer [104] is a semi-conducting pyrolyzed glass fiber layer as disclosed herein. . . . An insulation 106 surrounds internal grading layer 104. On the external surface of

> insulation 106, a semi-conducting pyrolyzed glass fiber layer 110 equalizes the electrical potential thereon.

(Elton ('165): column 2, lines 34-41).

As further evidence that cable 100 shown in Fig. 1 of Elton ('165) would not be suitable as a winding in an electric machine, having two pyrolyzed glass fiber layers would cause the cable to be prohibitively stiff for winding through the stator slots. It may be possible to VPI the entire stator in a large resin bath after it had been wound with a flexible cable. However, such a process would not be feasible to produce both the internal grading layer 104 and the external layer 110 since an insulation layer 106 surrounds the internal grading layer 104 and both layers 110 and 104 would need to be exposed to the resin. Accordingly, while Elton et al. ('565) describes how to provide a pyrolyzed glass fiber layer for a bar-type winding, Neither Elton ('565) nor Elton ('165) teach or suggest that cable 100 of Fig. 1 in Elton ('165) or Fig. 7 in Elton ('565) could be used for such a purpose, especially since cable 100 in the Elton et al. references would be stiff, not flexible as the Office contends.

Elton ('565) recognizes that in the end-winding region just outside of the stator of an electric machine, there will be problems caused by strong electric fields. As a solution, Elton ('565) describes using a known grading near the stator to allow some of the accumulated charge to bleed off to the stator, thus reducing the risk of arcing, but Elton ('565) offers no other solutions to the problems in the end-winding region. The strong electric fields will be present throughout the end-winding region, not just near the stator. The grading used in Elton ('565) will help to lessen the effects of the strong electric fields near the stator, but will not address the problems in the end-winding region away from the stator. Elton ('565) uses rigid bar-type windings which are able to withstand mechanical stresses caused by induced fields between the windings in the end-winding region, where electromagnetic fields are not contained in the winding. The mechanical rigidity of the bar-type windings suppress the

amount of vibration in the end-winding region that would otherwise be present. The fact that a grading system is used to lessen the end-winding region problems near the stator in Elton ('565) is further evidence that neither Elton ('565) nor Elton ('165) suggest using cable 100 winding of a machine, since such a cable would not have a grading.

The present invention specifically embodies a flexible cable winding and cable structure. The cable allows for a continuous full turn, making a joint in the end winding unnecessary. This, along with the fact that the outer surface of the cable is grounded, allows for the confinement of the electric field resulting in the diminished risks of losses and damage in the end winding region. Elton ('165) may teach a cable, however, in no way does it teach the cable as a winding.

Moreover, there is no likelihood of success. The MPEP § 706.02(j) sets forth the burden that the Office must carry in order to reject claims based on obviousness. One criteria that must be met is that there must be a reasonable expectation of success. This criteria cannot be met when the aforementioned references are combined.

Assuming for the sake of argument that the cable 100 recited in Elton ('165) is combined with the cable windings of Shildneck, there is no likelihood of success because of the inflexibility and brittleness of cable 100. The pyrolyzed glass layer of cable 100 would crack when attempted to be wound around a core. These cracks would, in effect, promote corona discharge as opposed to prohibit it, as is contended by the Office, resulting in losses attributed to the lack of confinement of the electric field, rendering the system inefficient. It is, therefore, not surprising that neither Elton ('565) nor Elton ('165) make any disclosure of the use of cable 100 as a "winding" in a dynamoelectric machine.

Accordingly, for at least the reasons set forth above, Applicants respectfully request that the rejection of claims 1-4, 6-8, 10, 12, 21, 31, 32, 34, 35 and 37 be reconsidered and

withdrawn. Applicants further submit, as an alternate ground of allowability, that claims 2-4, 6-8, 10, 12, 21, 31, 32 and 34 depend from base claim 1 (believed allowable), and therefore, include every limitation of the respective base claim. Inasmuch as base claims 1, 37 and 39 are believed to be allowable, Applicants respectfully submit that the respective dependent claims of each base claim are also allowable for at least the same reasons as the base claim is believed to be allowable. Accordingly, Applicants respectfully request that the rejection of the dependent claims be reconsidered and withdrawn in view of the believed allowability of base claims 1, 37 and 39.

The present invention is for protecting the cable forming the winding from damage as the cable is drawn through the circular openings in the stator. The invention does not require the same type of temperature stabilization as the reference, because high power generators operating at high voltage, according to the invention, operated at lower temperatures than conventional high power generators operating at high current levels. There is nothing in the cited references to suggest that it would be useful or desirable to use similar coefficients of expansion in a machine operating at relatively low temperatures.

REJECTION OF CLAIMS 9, 13-20, 30, 33 AND 39-49 UNDER 35 U.S.C. ' 103

Claims 9, 13-20, 30, 33 and 39-49 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Shildneck (U.S. Patent No. 3,014,139) and Elton et al. (U.S. Patent No. 5,036,165; "Elton ('165)"), and further in view of Takaoka et al. (U.S. Patent No. 5,094,703) and UK Specification 468,827, hereinafter Siemens. The Examiner contends that it would have been obvious to have used the teaching of Takaoka et al. having insulated and uninsulated electrical conductor strands shown in Figs. 7, 8, 10 and 11 and Siemens '827 having cylindrical openings with decreasing radii and to have modified the device of

Elton ('165) since such a modification would reduce the amount of insulation needed, minimizing assembly and production costs. Applicants respectfully traverse this rejection for at least the following reasons.

Regarding claims 9, 13-20 and 30, Applicants respectfully submit that such claims depend from independent base claim 1 (believed allowable), and therefore, includes every limitation thereof. For at least the reasons set forth above in Section II pertaining to the allowability of claim 1, Applicants respectfully submit that the dependent claims are likewise believed to be allowable. Accordingly, reconsideration and withdrawal of the rejection of these claims is hereby respectfully requested.

As an additional basis of allowability for the claims and with regard to claims 39-49, no motivation, incentive or suggestion to combine Shildneck and Elton et al. references, as is set forth above. Because the base combination is improper, any broader combination is likewise improper, therefore, the broader combination of the Takaoka et al. and Siemens references is improper.

Furthermore, Applicants respectfully assert that Takaoka et al. is simply a conventional device, which does not employ a high voltage cable as a winding. Takaoka et al. may disclose a conductor having insulated and uninsulated strands, however, the purpose of this feature in Takaoka et al. is to reduce the "skin effect" associated with self induced currents in a transmission and distribution cable. Takaoka et al. has nothing to do with a cable winding where power is generated, much less reducing a phenomena called eddy currents which develop when the cable is used as a winding of an electromagnetic device.

In the present invention, the insulated strands reduce eddy current losses by restricting the paths for such currents between the conductive strands. Eddy currents are induced in the winding as a result of the exposure of the winding to high magnetic fields in the rotating

electric machine. These currents are problematic in these applications because they create electrical losses which are manifested as thermal energy (heat), which in turn causes a number of reliability problems in rotating machines. The device from the Takaoka et al. reference is not subjected to these problems associated with eddy currents because transmission and distribution cables are not subjected to the localized high magnetic field.

It is also necessary to employ at least one uninsulated strand in the instant invention to make contact with the semiconductive layer to set up an equipotential field, thereby confining the electric field within the winding and allowing for its use as a high voltage winding. In Takaoka et al., the outer strands are insulated because that is where the skin effect current flows. Accordingly, Takaoka et al. teach away from the invention (as claimed) because in the invention, the outer strand or strands are uninsulated for a different purpose. Therefore, in view of the foregoing, Applicants contend that one of ordinary skill in the art to which the invention pertains would not look to Takaoka et al.. Takaoka et al. do not disclose a cable as a winding, and the cable therein is not employed in high voltage applications.

Accordingly, for at least the reasons set forth above, Applicants respectfully request that the rejection of the above claims be reconsidered and withdrawn. As an additional ground of allowability, Applicants respectfully submit that dependent claims 34-44 depend from base claim 33 (believed allowable), and therefore, include every limitation thereof. Accordingly, inasmuch as base claim 33 is believed to be allowable, Applicants respectfully submit that the corresponding dependent claims are likewise allowable.

Siemens is asserted for teaching a decreasing slot radius. However, the teachings of Siemens do not cure the problems discussed above regarding the combination of Shildneck, Elton and Takaoka. Siemens, as shown in Figure 1 thereof, includes a "plurality of individually insulated slot conductors" (column 1, lines 18 B 19) shown as elements a_1 and a_3

in Figure 1 in slots of a stator. The first conductor, conductor a_1, will have a lower potential, and therefore a thinner amount of insulation (insulation i_1) disposed around it. Likewise, separate conductors a_2 and a_3 include progressively greater amounts of insulation thereabout depending on the amount of electric potential developed on the separate conductors. The reason for using separate conductors in the machine in Siemens is so that if the different conductors become damaged, it is simple to replace a damaged section (column 1, lines 37-40). Also, applying progressively more insulation to conductors further from the core, enables those conductors with a low potential on them, to not have an unnecessary amount of insulation thereabout, while the outer conductors which have a higher potential will have a thicker insulation layer. Siemens explains that this graduation "ensures maximum utilization of space" (column 1, lines 34 B 36). Accordingly, a basic feature of Siemens that helps achieve a maximum utilization of space and facilitate the replacement of a damaged section is to employ groups of conductors, that are "separately insulated" (column 2, line 59). It is submitted that Siemens adds nothing to the combination which would suggest the invention.

A number of critical ideas had to be combined in order to make a workable and practical system which has now been successfully commercialized. It was only when the critical characteristics and functions were identified that it became possible to proceed to assemble the necessary components and material to build a workable and practical system.

It should be noted that the challenges facing the inventors when trying to develop a high-voltage power generator were in large part related to areas that would be of no concern to a transmission and distribution cable designer. Developing an insulation system that could be used in a continuously operating machine, with many windings to generate the desired voltages situated adjacent to one another causing heat problems, preventing eddy currents in the windings, dealing with the vibrations in the windings, among others are all problems that

would not face a cable engineer. Accordingly, it is hoped that this discussion makes it clear that it is not reasonable to presume that a generator engineer, seeking to solve problems unique to the operational environment of a high power would look to transmission and distribution cable technology for solutions.

In view of the foregoing, it is respectfully requested that the Examiner reconsider his rejection of the claims, the allowance of which is earnestly solicited.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Page 6, line 37 through page 7, line 6, as amended:

Against this background, one object of the invention is to provide a better synchronous compensator plant than is possible with known technology, by reducing the number of electrical components necessary when it is to be connected to high-voltage networks, including those at a voltage level or 36 kV and above.

[This object has been achieved according to a first aspect of the invention in that a plant of the type described in the preamble to claim 1 comprises the special features defined in the characterizing part of the claim.]

Page 11, lines 1-24, as amended:

The invention also relates to a procedure for manufacturing the magnetic circuit for the electric machine included in the synchronous compensator plant. The procedure entails the winding being placed in the slots by threading the cable through the cylindrical openings in the slots.

[From another aspect of the invention, the object has been achieved in that a plant of the type described in the preamble to claim 35 is given the special features defined in the characterizing part of this claim.]

Since the insulation system, suitably permanent, is designed so that from the thermal and electrical point of view it is dimensioned for over 36 kV, the plant can be connected to high-voltage power networks without any intermediate step-up transformer, thereby achieving the advantages referred to above. [Such a plant is preferably, but not necessarily, constructed to include the features defined for the plant as claimed in any of claims 1-34.

The above-mentioned and other advantageous embodiments of the invention are defined in the dependent claims.]

Page 11, lines 33-37, as amended:

Figure 2 shows a schematic axial end view of a sector of the stator in an electric machine in the synchronous compensator plant according to the invention, [and]

Figure 3 shows an end view, step-stripped, of a cable used in the winding of the stator according to Figure 2, and

Figure 4 is a schematic illustration of a three-phase synchronous compensator plant in accordance with the present invention. The suppression filter 48 may be of a third harmonic type for reducing or eliminating third harmonic currents.

Page 12, lines 6 through 23, as amended:

In the schematic axial view through a sector of the stator 1 according to Figure 2, pertaining to the electric machine included in the synchronous compensator plant, the rotor 2 of the machine is also indicated. The stator 1 is composed in conventional manner of a laminated core 1'. Figure 1 shows a sector of the machine corresponding to one pole pitch. From a yoke part 3 of the core situated radially outermost, a number of teeth 4 extend radially in towards the rotor 2 and are separated by slots 5 in which the stator winding is arranged. Cables 6 forming this stator winding, are high-voltage cables which may be of substantially the same type as those used for power distribution, i.e. PEX cables. One difference is that the outer, mechanically-protective sheath, and the metal screen normally surrounding such power

distribution cables are eliminated so that the cable for the present application comprises only the conductor and at least one semiconducting layer on each side of an insulating layer. Thus, the semiconducting layer which is sensitive to mechanical damage lies naked on the surface of the cable.

Page 12, line 39 through page 13, line 15, as amended:

Figure 3 shows a step-wise stripped end view of a high-voltage cable for use in an electric machine according to the present invention. The high-voltage cable 6 comprises one or more conductors 31, each of which comprises a number of strands 36 which together give a circular cross section of copper (Cu), for instance. These conductors 31 are arranged in the middle of the high-voltage cable 6 and in the shown embodiment each is surrounded by a part insulation 35. However, it is feasible for the part insulation 35 to be omitted on one of the four conductors 31. The number of conductors 31 need not, of course, be restricted to four, but may be more or less. The conductors 31 are together surrounded by a first semiconducting layer 32. Around this first semiconducting layer 32 is an insulating layer 33, e.g. PEX insulation, which is in turn surrounded by a second semiconducting layer 34. Thus the concept "high-voltage cable" in this application need not include any metallic screen or outer sheath of the type that normally surrounds such a cable for power distribution.

In accordance with the present invention, the synchronous compensation plant of the invention provides quadrature-axis synchronous reactance which is considerably less than the direct-axis synchronous reactance. In other words, out of phase synchronous reactance is reduced.

Figure 4 illustrates an arrangement of the invention employing three phase compensation. According to the invention, an exciter 40, which may be a positive or negative

exciter, is coupled to the phases 42a, 42b and 42c of a rotating machine. The phases 42 are Y connected having a neutral point 44 which is connected to ground 46 via a suppression filter 48. A surge arrester 50 may be coupled in parallel with the suppression filter 48 as shown. A cooling means 52 employing either gas or liquid working fluid 54 may be provided in heat exchange relation with the phases 42 of the arrangement illustrated.

IN THE CLAIMS:

35. (Amended) [The] A synchronous compensator plant comprising at least one rotating electric machine having at least one winding, wherein the winding has an insulation system which, as regards its thermal and electrical properties, permits a voltage level in the machine exceeding 36 kV.

37. (Amended) [The] A rotating electric machine in the form of a synchronous compensator having at least one winding, wherein the winding comprises an insulation system including at least two semiconducting layers, each layer constituting essentially one equipotential surface, with solid insulation disposed therebetween.

39. (Amended) A synchronous compensator plant including a rotating high voltage electric machine comprising a stator; a rotor and a winding, wherein said winding comprises a cable including at least one current-carrying conductor including a plurality of insulated strands and a lesser plurality of uninsulated strands and a [magnetically permeable, electric field confining] cover surrounding the conductor in electrical contact with the uninsulated strands, including an inner layer surrounding the conductor and being in electrical contact therewith; an insulating layer surrounding the inner layer; and an outer semiconducting layer

surrounding the insulating layer, said cable forming at least one uninterrupted turn in the corresponding winding of said machine.

49. (Amended) The synchronous compensator plant of claim 39, wherein the winding [comprises multiple uninterrupted turns] is threaded through openings formed in the stator.

50. (Amended) The synchronous compensator plant of claim 39, wherein the [core] cover is flexible.